

National Aeronautics and Space Administration
Goddard Earth Science Data Information and
Services Center (GES DISC)

README Document – A Broad Overview of TRMM Products Transitioning into the GPM Era

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Introduction

This is a preliminary document compiled from different currently available documents. The intent is to provide data users with essential information for understanding the transition of Tropical Rainfall Measuring Mission (TRMM) data sets in the Global Precipitation Measurement (GPM) era. Beginning with TRMM Version 8 (V8) reprocessing, TRMM data becomes part of the GPM data suite, with GPM algorithms used for reprocessing. TRMM data format, as well as file naming conventions, are now consistent with those of GPM.

We would like to highlight the most important release notes relevant to TRMM “V8” reprocessing:

Changes to TRMM Precipitation Radar (PR) Level 1.....	page 3
Changes to TRMM Microwave Imager (TMI) calibration.....	page 4
TRMM Visible and Infrared Sensor (VIRS) calibration release notes.....	page 5
TMI L1C release notes.....	page 6
TRMM new naming convention.....	page 14
(excerpted from a Precipitation Processing System (PPS) document; the full document may be found at https://pps.gsfc.nasa.gov/Documents/FileNamingConventionForPrecipitationProductsForGPMMission.pdf)	
PPS primer overview, mapping between old and new product names.....	page 21
PPS primer, mapping between old and new data fields.....	pages 22-28
Goddard Earth Sciences Data and Information Services Center (GES DISC) data set naming.....	page 30

For those users seeking a highly detailed, in-depth specification of TRMM and GPM products, a document (not included in this readme) is available at the following link:
<ftp://gpmweb2.pps.eosdis.nasa.gov/pub/GPMfilespec/filespec.GPM.pdf>

We recognize that TRMM “V8” reprocessing may create confusion with TRMM data versions and language used. At this time (July 2018), we remind users that TRMM Precipitation Radar Level 2 and 3 products (precipitation retrievals), including combined radar-radiometer precipitation and latent heat, will be Version 6. TRMM Level 1 and the new TRMM TMI GPROF products are Version 5.

The new TRMM products can be searched by using the following links:

[https://disc.gsfc.nasa.gov/datasets?keywords="](https://disc.gsfc.nasa.gov/datasets?keywords=)TRMM V05”

[https://disc.gsfc.nasa.gov/datasets?keywords="](https://disc.gsfc.nasa.gov/datasets?keywords=)TRMM V06”

The GES DISC wishes to acknowledge the efforts of the PPS team at NASA Goddard Space Flight Center (GSFC) whose documents are included in this readme.



Oct 3rd, 2017

Release Notes for the PR Level 1 products

All users of PR Level 1 data should keep in mind the following changes in Version 5 products.

<Major changes in the PR Level 1 products from TRMM Version7 to GPM Version 5>

1. Changes of the PR's calibration parameters.

JAXA reexamined the PR's calibration parameters in the GPM Version 5 products based on a new knowledge obtained by GPM/DPR's calibration. With the new parameters, the measured radar reflectivity factors increase by about +1.1 dB for PR from the corresponding TRMM Version 7 products, and PR's normalized surface cross section (σ_0) statistics agrees with KuPR's σ_0 .

2. Improvements of beam-mismatch correction.

The TRMM orbit boost from 350 km to 402.5 km in August 2001 caused a mismatch of transmitted and received antenna directions by one pulse due to a design of PR's hardware (called as "beam-mismatch"). Although the beam-mismatch has been partially corrected by Takahashi and Iguchi (2004) in TRMM Version7 products, a systematic bias by its correction error has been found. JAXA applied a new correction method in GPM Version5 products to mitigate the correction error (Kanemaru et al., in preparation).

3. Improvements of geolocation.

Since satellite attitude and orbit information was reexamined by NASA/PPS, geolocation of the PR's IFOV (Instantaneous Field of View) was improved.

4. Data format was changed to the GPM/KuPR's format.

PR Level 1 product format in GPM Version 5 was changed to be the same with KuPR Level 1 product in GPM Version 5. Users can refer to following web site.

http://www.eorc.jaxa.jp/TRMM/documents/PR_algorithm_product_information/top_e.html

RELEASE NOTES OF GPM VERSION 05/TRMM VERSION 08 TMI CALIBRATION

This release of Tropical Rainfall Measuring Mission (TRMM) Version 08 (V08) data will become part of the Global Precipitation Measurement (GPM) data suite. The TRMM V08 TRMM Microwave Imager (TMI) calibration and correction are updated based on deep space and special maneuver data, as well as advanced algorithms used in GPM Microwave Imager (GMI) calibration. Updates include Antenna Pattern Correction (APC) and antenna emissivity correction (these have major impacts on brightness temperature, T_b) and a number of other updates described below. The magnitudes of T_b changes can be seen in Figure 1. The T_b s are increased around 2-3 K at the low end of T_b for most channels, reflecting an over warm-correction of V07 for cold T_b . Corrections at the warm end are small, except for 19 GHz channels.

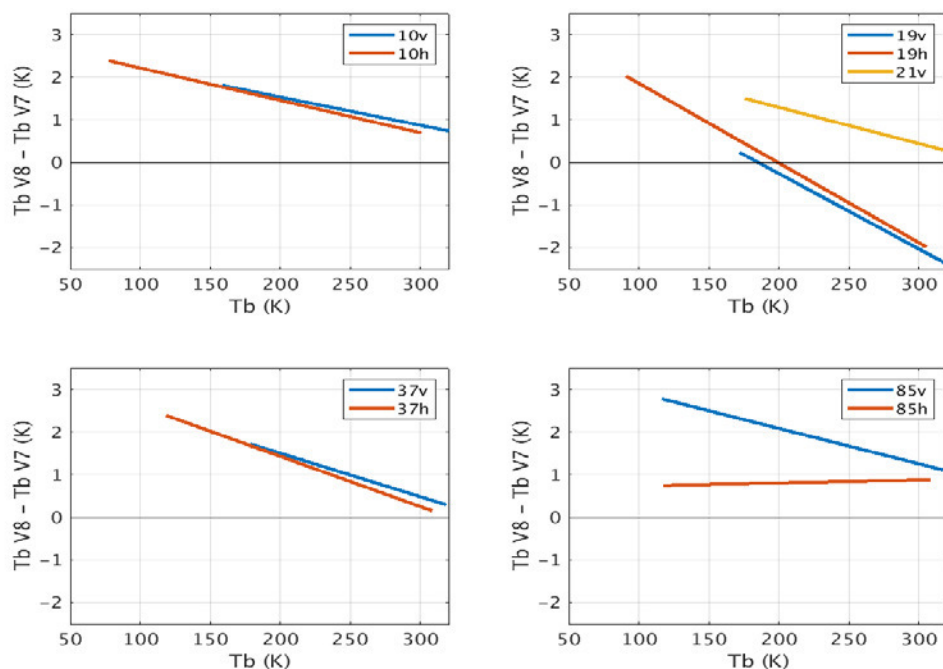


Figure 1. TMI T_b changes from V07 to V08.

1. Adjusted TMI APC. This adjustment is the major improvement from V07 to V08 in TMI antenna pattern correction. The adjustment is based on the data from TMI deep space and other special maneuvers, and refinements of the analysis from the GPM Inter-calibration Working Group (X-CAL). T_b changes vary from channel to channel and are functions of brightness temperatures.
2. Added TMI emissive antenna correction to replace the V07 empirical warm correction. The adjustment is based on the data from TMI deep space and other special maneuvers, and refinements of the analysis from X-CAL. T_b changes vary from channel to channel and are functions of brightness temperatures.
3. Used multiple scan calibration to replace the V07 single scan calibration. This reduced the along-track noise ± 0.5 K but has no impact on long-term average.
4. Added correction on warm intrusions (Moon and Radio Frequency Interference) onto cold load and Sun intrusions onto the hot load. These events typically last less than a few hundred scans for some orbits.

RELEASE NOTES OF GPM VERSION 05/TRMM VERSION 08 VIRS CALIBRATION

This release of Tropical Rainfall Measuring Mission (TRMM) Version 08 (V08) data will become part of the Global Precipitation Measurement (GPM) data suite.

1. No change of radiometric calibration from V07 to V08. Radiances for all Visible and Infrared Sensor (VIRS) channels are identical between V07 and V08.
2. V08 added computation of surface reflectance for visible channels and brightness temperatures (T_b) for infrared channels. The V08 VIRS Level 1B (L1B) products contain radiance for all channels, as well as surface reflectance for channels 1 and 2 and T_b for channels 3, 4, and 5. V07 products do not have surface reflectance and T_b .

TRMM Version 8 Level 1C Release Notes

Tropical Rainfall Measuring Mission (TRMM) Version 8 (V8) fully incorporates TRMM data into Global Precipitation Measurement (GPM) data processing. TRMM and constellation products become part of the GPM data suite. Products are all in GPM HDF5 format and are labeled with product version V05.

1. TRMM V8 Level 1C TRMM Microwave Imager (TMI) brightness temperature (T_c) differs from TRMM V7 by as much as 2.3 K for some channels (see Figure 1) due to the following changes:
 - A. Improvements implemented in the V8 TMI L1B/1Base level:
 - Adjusted TMI APC. This adjustment is the major improvement from V7 to V8 in TMI antenna pattern correction. The adjustment is based on the data from TMI deep space and other special calibration maneuvers, and refinements of the analysis from the GPM Intercalibration Working Group (X-CAL).
 - Added TMI emissive antenna correction to replace the V7 empirical warm correction. The adjustment is based on reflector emissivities as a function of frequency derived using the data from TMI deep space and other special calibration maneuvers, derived reflector physical temperatures, and refinements of the analysis from the X-CAL team.
 - Used multiple scan calibration averaging to replace the V7 single scan calibration.
 - Added correction on warm intrusions (Moon and RFI) onto cold load and Sun intrusions onto the hot load.
 - Updates to the TRMM spacecraft attitude.
 - Updated view-angle offsets for the TMI feedhorns based on geolocation analysis for more accurate pointing information by channel.
 - Updated the cross-scan bias corrections to account for scene temperature dependent differences based on an analysis over both cold (ocean) and warm (land) scenes.
 - B. In addition to the L1B/1Base level T_b changes, TRMM V8 Level 1C TMI brightness temperature (T_c) has been intercalibrated to be consistent with the V05 GPM Microwave Imager (GMI) brightness temperature. The V7 TMI T_c had no intercalibration applied.

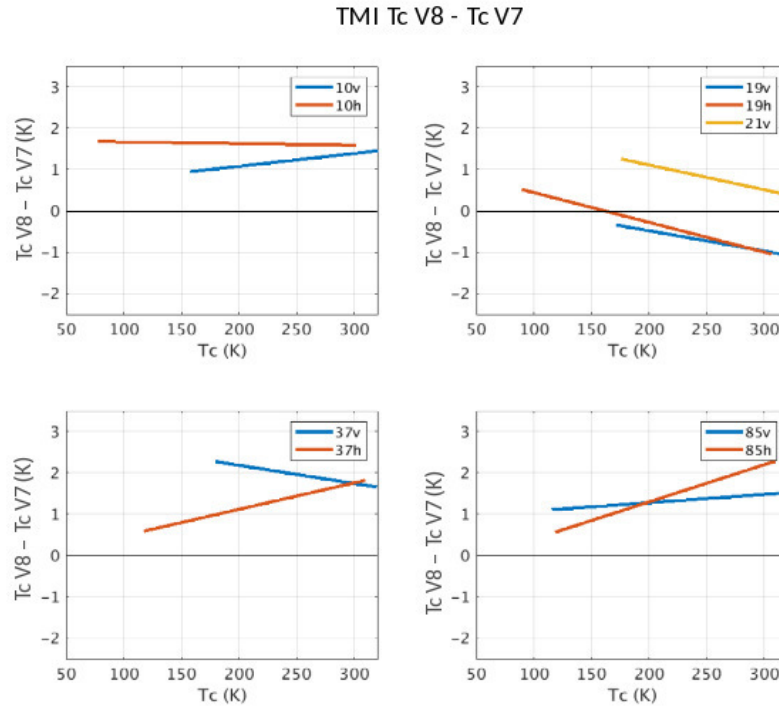


Figure 1. TMI L1C Mean Tc Differences Between V8 and V7 (January 2014)

2. TRMM V8 Level 1C TMI brightness temperature (also known as GPM V05 Tc) differs from GPM V04 1C TMI Tc by as much as 1.2 K at the cold end and -1.6 K at the warm end for some channels (see Figure 2) due to the following changes:
 - A. Same improvements as described in 1.A.
 - B. TRMM V8 (or GPM V05) TMI Tc has been intercalibrated to be consistent with the V05 GMI brightness temperature, while GPM V04 TMI Tc was intercalibrated to V04 GPM GMI brightness temperature.

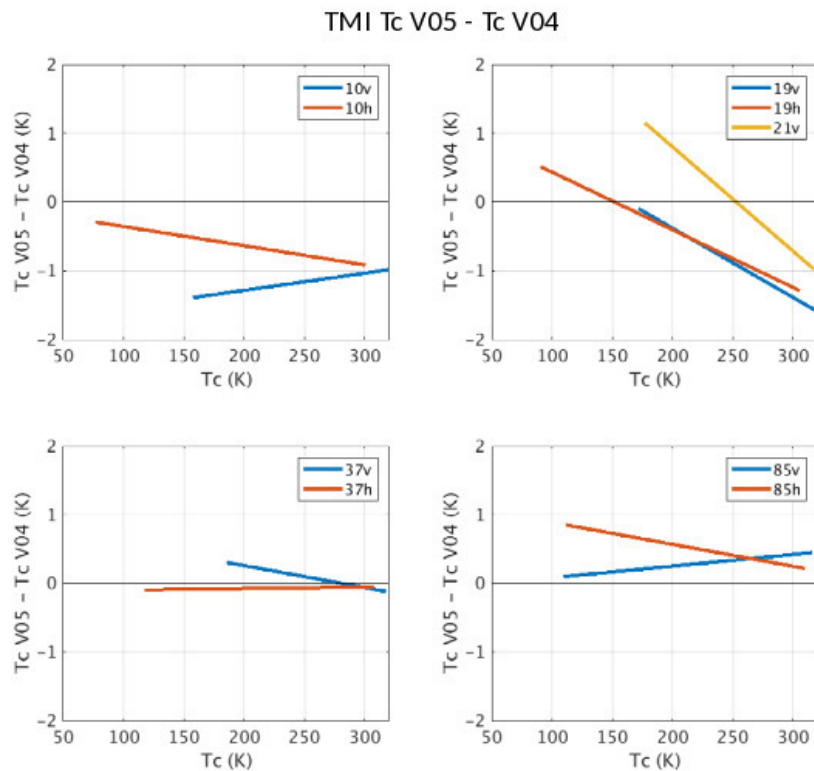
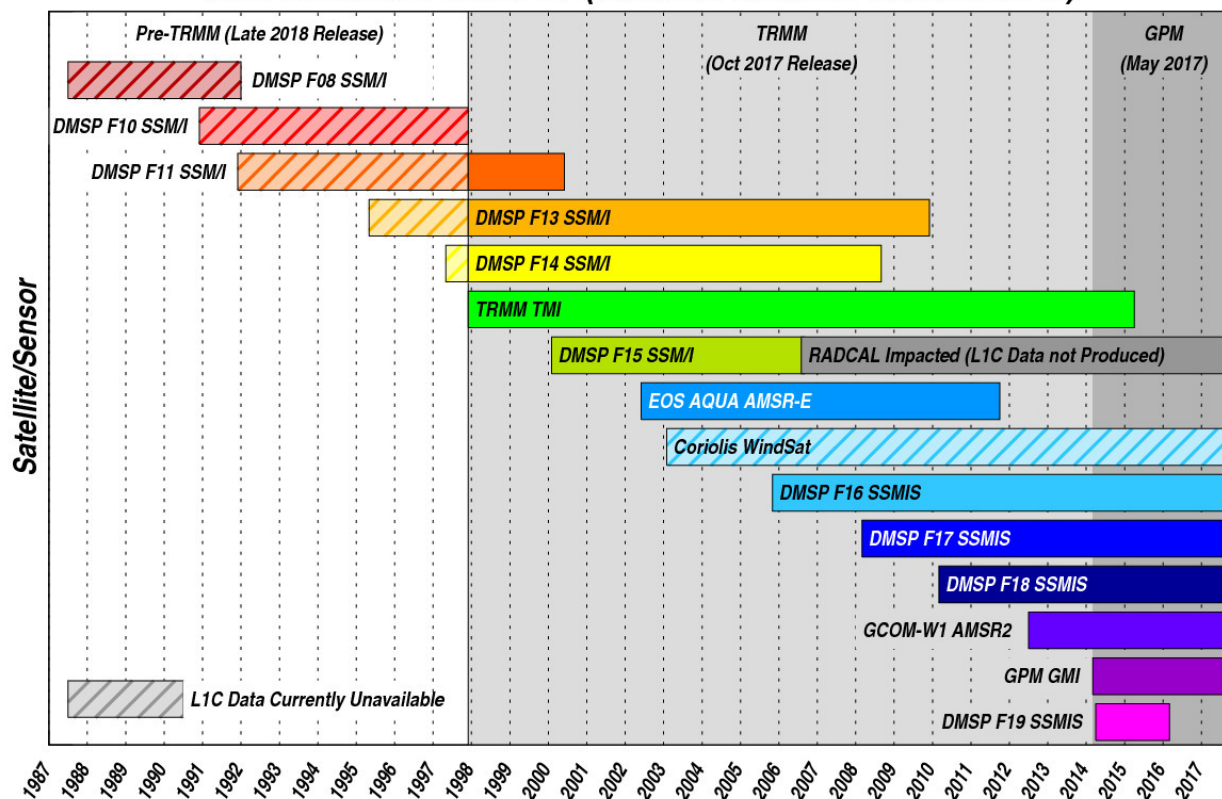


Figure 2. TMI L1C Mean Tc Differences Between V05 and V04 (March 2014)

- For all partner radiometers, the Level 1C brightness temperature (Tc) data has been intercalibrated to be consistent with the V05 GMI brightness temperature. See Figure 3 for TRMM constellation data availability.

Intercalibrated Level 1C (Window Channel Radiometers)



Intercalibrated Level 1C (Cross-Track Sounding Radiometers)

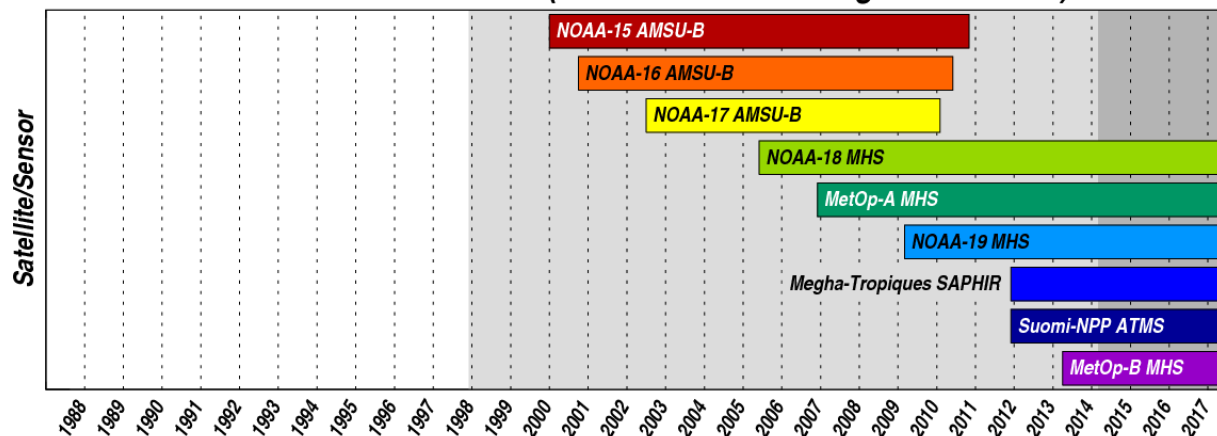


Figure 3. Level 1C Data Availability for Version 8 TRMM Constellation

4. Based on the X-CAL team’s recommendation, some data has been flagged as “bad” or “caution” in the Level 1C product due to poor data quality, sensor issues or failure. A detailed report on the Advanced Microwave Sounding Unit – B (AMSU-B) data quality from the X-CAL team is attached (Appendix A).

Sensor	Channel	Start Date (Orbit)	End Date (Orbit)	Flag	L1C Tc
SSMIS F16	150 H	20150501 (59504)	20150826 (61160)	Bad	Set to missing
	183+/-1 H	20131201 (52214)	20150826 (61160)	Bad	Set to missing
	183+/-3 H	20131201 (52214)	20150826 (61160)	Bad	Set to missing
	183+/-7 H	20131201 (52214)	20150826 (61160)	Bad	Set to missing
	91 V	20150424 (59413)	20150826 (61160)	Caution	
	91 H	20150424 (59413)	Ongoing	Caution	
SSMIS F17	37 V	20160405 (48595)	20160518 (49201)	Bad	Set to missing
	37V	20160803 (50286)	Ongoing	Bad	Set to missing
SSMIS F18	150 H	20120214 (11988)	Ongoing	Bad	Set to missing
AMSU-B NOAA-15	89	20090101 (55297)	End of mission	Bad	Set to missing
	183+/-1	20090101 (55297)	End of mission	Bad	Set to missing
	183+/-3	Begin	End of mission	Bad	Set to missing
	183+/-7	20090101 (55297)	End of mission	Bad	Set to missing
AMSU-B NOAA-16	183+/-1	20080101 (37503)	End of mission	Bad	Set to missing
	183+/-3	20080101 (37503)	End of mission	Bad	Set to missing
	183+/-7	20080101 (37503)	End of mission	Bad	Set to missing
AMSRE AQUA	89 A V+H	20041104 (13322)	End of mission	Bad	Set to missing

Appendix A

AMSU-B V05 Level 1C Release Notes (July 31, 2017)

The Advanced Microwave Sounding Unit-B (AMSU-B) is a cross-track scanning humidity profiler with channels near the 183 GHz water vapor line that flew on board the NOAA-15, -16, and -17 polar-orbiting spacecraft. Coincident observations were compared between the various AMSU-B sensors (Version TRMM005) and the Microwave Humidity Sounders (MHS) on NOAA-18 and MetOp-A. The MHS brightness temperatures (Tb) were recalibrated to GPM GMI (V05), which was adopted by the X-CAL team as the calibration standard for all the radiometers in the TRMM/GPM radiometer constellation.

Data Quality: The performance of the AMSU-B instruments on board both NOAA-15 and -16 was generally very poor, while the data from the NOAA-17 AMSU-B was quite good. Intercalibration offsets are applied to the Tb for the data range indicated by the green bars “good” in Figure 1, with the Tb corresponding to channels indicated by the red bars “bad” set to missing. Even within the “good” range, however, the data should be used with caution as there are variations in the calibration and biases across the scan that vary over time. The 183 ± 3 GHz channel on NOAA-15 was especially problematic and has thus been set to missing over the entire data record. We do not consider this channel to be useful for any application. Both NOAA-15 and -16 also had severe degradation starting in 2008 for several of the NOAA-16 channels and in 2009 for several of the NOAA-15 channels (see Figure 2).

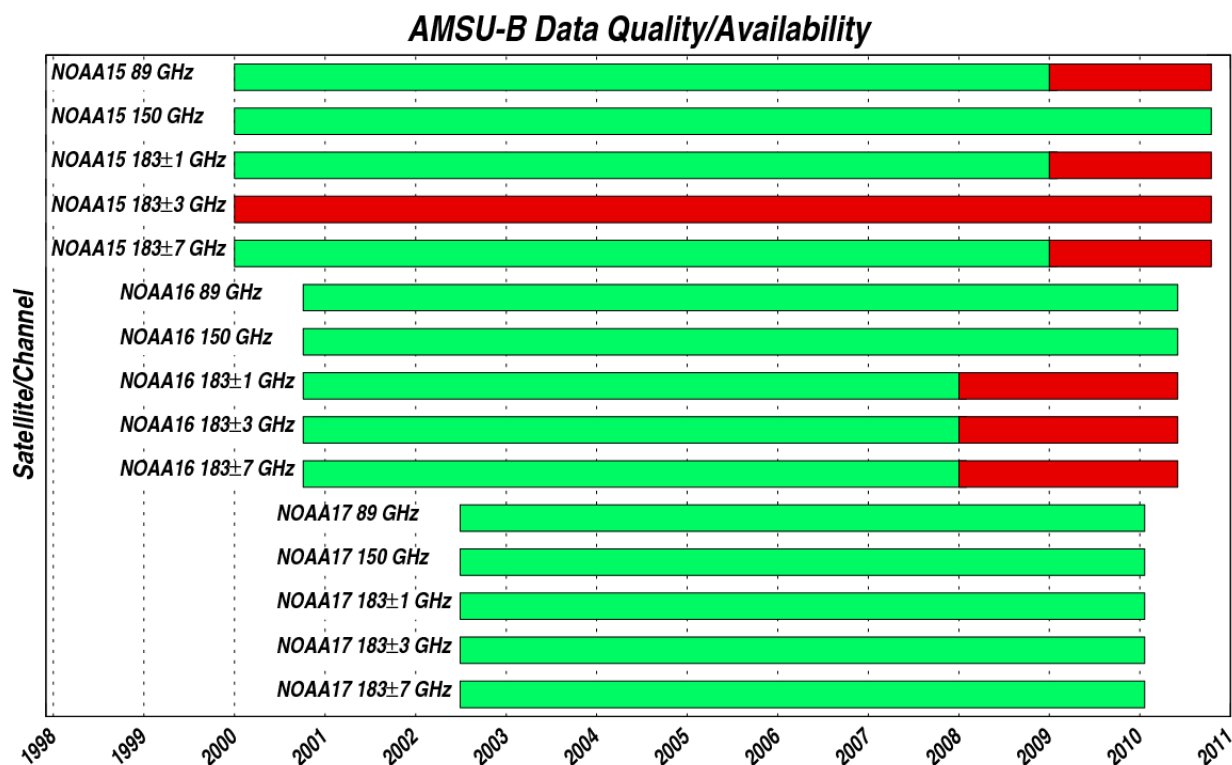


Figure 1: Data availability by channel for the AMSU-B instruments on board NOAA-15, -16 and -17. Green indicates data is useable, while red indicates that the data for a given channel has been flagged as bad and set to missing in the Level 1C data files.

NOAA-15 AMSU-B

89.0 GHz	Useable through December 2008
150 GHz	Useable over entire data record
183±1 GHz	Useable through December 2008
183±3 GHz	Not useable over entire data record
183±7 GHz	Useable through December 2008

NOAA-16 AMSU-B

89.0 GHz	Useable over entire data record
150 GHz	Useable over entire data record
183±1 GHz	Useable through December 2007
183±3 GHz	Useable through December 2007
183±7 GHz	Useable through December 2007

NOAA-17 AMSU-B

89.0 GHz	Useable over entire data record
150 GHz	Useable over entire data record
183±1 GHz	Useable over entire data record
183±3 GHz	Useable over entire data record
183±7 GHz	Useable over entire data record

Time series of simulated minus observed Tb for the 183 GHz channels are shown in Figure 2 below for the AMSU-B instruments on board NOAA-15, -16 and -17 as well as the four MHS instruments on board NOAA-18 and -19 and MetOp-A and -B. This figure clearly shows the substantial degradation in the calibration in the NOAA-15 and -16 channels, as well as the variability in the 183±3 GHz channel for AMSU-B on board NOAA-15. Note that these are average differences, although the standard deviation in the single difference values also increases dramatically for NOAA-15 and -16 resulting in much larger instantaneous calibration errors that can have significant impacts on precipitation and other geophysical parameter retrievals.

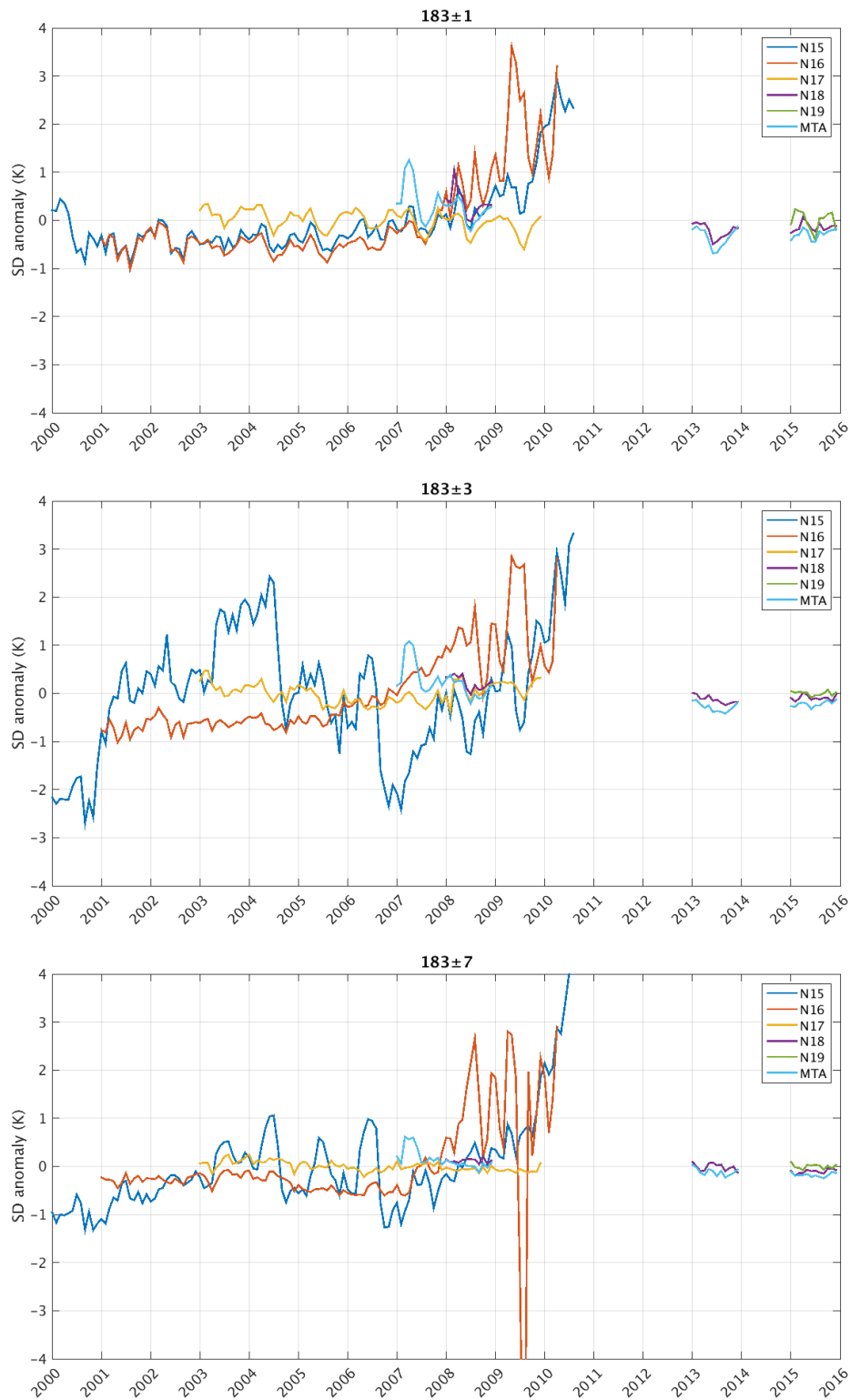


Figure 2: Time series of single differences (Observed – Simulated Tb) for the 183 GHz channels of the TRMM/GPM cross-track sounders. These plots and the associated analysis were produced by Rachael Kroodsma at NASA’s Goddard Space Flight Center.

APPENDIX B. CHANGE OF NAMING CONVENTION FOR TRMM DATA UPON INTEGRATION INTO THE GPM DATA SUITE

B-1. BACKGROUND

Throughout the Tropical Rainfall Measuring Mission (TRMM) era, the names of TRMM products have always used a numeric code that represented the processing level and the instrument(s) that provided the data for the product. The following was the convention used through the TRMM Version 7 (V7) reprocessing period and beyond:

9X99

The first digit (placeholder 9) indicated the processing level. Level 1 was the first level of processing at instrument field of view (IFOV), Level 2 was the retrieval processing at IFOV, and Level 3 indicated space and time gridded retrievals.

The first alphabetic character indicated whether the data came from a single instrument, in which case the character would be *A*, or from multiple instruments, in which case the character would be *B*. Only these two letters were used in TRMM standard products. However, the special gridded text product used the letter *G* to indicate “gridded,” and heating products used the letter *H* to indicate “heating.”

The first digit following the letter indicated which instrument was used in the product. The following were the approved values for this digit:

- 0 – Visible and Infrared Scanner (VIRS)
- 1 – TRMM Microwave Imager (TMI)
- 2 – Precipitation Radar (PR)
- 3 – PR and TMI Combined
- 4 – TRMM and Others Combined

The final digit in the identification part of the name indicated which of perhaps several products of the instrument were contained in the file.

This alphanumerical identification of products provided a great deal of information in a very short and consistent length identifier. For regular users of TRMM data, the identifier quickly became a shorthand for describing the product. However, for occasional users of the TRMM data, the alphanumeric identifier was not particularly descriptive. Within the Global Precipitation Measurement (GPM) Mission there were to be many sensors and satellites. The simple TRMM identification approach would have required a table that mapped numeric spacecraft/instrument combinations to specific digits. As a result, for GPM, the decision was made to replace these alphanumeric identifiers with a more descriptive file naming convention.

Beginning with TRMM Version 8 (V8) reprocessing, TRMM data will become part of the GPM data suite, and TRMM itself will become an historical member of the GPM constellation. GPM algorithms will be used to reprocess TRMM data, and GPM file naming conventions will be used to name the reprocessed TRMM data products. At each reprocessing of GPM, TRMM data back to the beginning of the TRMM mission will be included in the reprocessing. The TRMM V8 reprocessing will use GPM Version 5 (V05) algorithms. As a result, TRMM V8 data will receive a GPM data product version of V05. This document will provide a mapping of all TRMM V8 products to the GPM file naming.

B-2. PRE-V8 TRMM STANDARD PRODUCT FILE IDENTIFIERS

1A01	VIRS count packet data
1A11	TMI count packet data
1A21	PR count packet data
1B01	VIRS IFOV radiances
1B11	TMI IFOV brightness temperatures (Tb)
1B21	PR 3D IFOV radar powers
1C21	PR 3D IFOV reflectivities
2A12	TMI GPM Profiling Algorithm (GPROF) precipitation retrievals at IFOV
2A21	PR Sigma 0 at IFOV
2A23	PR precipitation classification at IFOV
2A25	PR 3D precipitation retrieval at IFOV
2B31	TMI/PR 3D Combined instrument precipitation retrieval at IFOV
3A11	5 deg x 5 deg Tb to precipitation monthly retrievals
3A12	.5 deg x .5 deg GPROF monthly precipitation retrievals
3A25	.5 deg x .5 deg PR monthly precipitation retrievals
3B31	.5 deg x .5 deg Combined monthly precipitation retrievals
3B42	.25 deg x .25 deg 3-hourly merged radiometer/Infrared (IR) product
3B43	.25 deg x .25 deg monthly merged radiometer/IR product
2H25	IFOV Spectral Latent Heating (SLH) latent heating retrievals from PR products
3G25	.5 deg x .5 deg SLH gridded orbital latent heating from PR
3H25	.5 deg x .5 deg SLH monthly latent heating data from PR
2H31	IFOV Convective Stratiform Heating (CSH) latent heating retrievals from Combined product
3G31	.5 deg x .5 deg CSH gridded orbital latent heating data from Combined
3H31	.5 deg x .5 deg CSH monthly latent heating data from Combined

B-3. GENERAL FORMAT GPM FILE NAMING CONVENTIONS

Major components of the file name are separated by the '.' dot character. Subcomponents of a major component are divided by the '-' dash character.

Major components in GPM file name are as follows:

1. Processing level
2. Satellite
3. Instrument
4. Algorithm ID/version
5. Date/Time of data in file
6. Orbit number or sequence number
7. Product version number
8. File format indicator

The governing document for this is the File Naming Convention for Precipitation Products for the Global Precipitation Measurement (GPM) Mission, PPS_610.2_P550, Version 1.4.4, October 14, 2015.

For example:

2B.TRMM.PRTML.CORRA2017.20150101-S195050-E202055.000321.V05A.HDF5

This is a TRMM V8 reprocessed Combined retrieval output in HDF5 format.

B-4. TRMM V8/GPM V05 VIRS NAMES

There are only two products for VIRS: Level 1A Consultative Committee for Space Data Systems (CCSDS) packet data as received from the TRMM Sensor Data Processing Facility (SDPF), and the Level 1B orbital radiance file.

During V8 reprocessing, the 1A product will be orbitized, the counts geolocated, and the unpacked data stored in HDF5 files:

1A.TRMM.VIRS.VCOUNT2017.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5

The radiance 1B will be:

1B.TRMM.VIRS.RAD2017.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5

In both cases the algorithm ID/version is just an example. The actual names may be totally different at the time of reprocessing. Also, while the data product will certainly be V05, the version letter may be something other than A should it be necessary.

B-5. TRMM V8/GPM V05 TMI NAMES

During Version 8 reprocessing, TMI will add a 1Base product and a standard 1C product. Also, the Level 3 products will add a daily gridded product. Gridded products will be on a .25 deg x .25 deg grid rather than the previous .5 deg x .5 deg grid. In addition, the 1A product will be orbital and contain geolocated counts rather than be an unpacked CCSDS packets binary file:

```
1A.TRMM.TMI.TCOUNT2017.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5
1Base.TRMM.TMI.TB2017.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5
1B.TRMM.TMI.TB2017.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5
1C.TRMM.TMI.XCAL2017-C.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5
2A.TRMM.TMI.GPROF2017v1-0.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5
3A-DAY.TRMM.TMI.GRID2017R1.YYYYMMDD-SHHMMSS-EHHMMSS.DDD.V05A.HDF5
3A-MO.TRMM.TMI.GRID2017R1.YYYYMMDD-SHHMMSS-EHHMMSS.MM.V05A.HDF5
```

Algorithm ID/versions are only examples; actual ones will be assigned during reprocessing. The daily Level 3 products have “DDD” in the sequence/orbit field to represent the day of year 001 – 366. The monthly Level 3 products have “MM” in the sequence/orbit field to represent the month 01 – 12.

B-6. TRMM V8/GPM V05 KU-BAND (KU) PR NAMES

Gridded products will be on a .25 deg x .25 deg grid rather than the previous .5 deg x .5 deg grid. Currently there are no plans to change the existing TRMM Ku Level 1A products as part of V8 TRMM reprocessing; as a result, the names for TRMM 1A Ku products will likely remain as they were for V7:

```
1B.TRMM.PR.POWER2017.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5
2A.TRMM.PR.V8.YYYYMMDD.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5
3A-DAY.TRMM.PR.GRID2017R1.YYYYMMDD-HHMMSS-EHHMMSS.DDD.V05A.HDF5
3A-MO.TRMM.PR.GRID2017R1.YYYYMMDD-SHHMMSS-EHHMMSS.MM.V05A.HDF5
```

The existing 2A21, 2A23, and 2A25 will all be combined into a single Level 2 retrieval product just as they are in GPM. Algorithm ID/versions are only examples; actual ones will be assigned during reprocessing. The daily Level 3 products have “DDD” in the sequence/orbit field to represent the day of year 001 – 366. The monthly Level 3 products have “MM” in the sequence/orbit field to represent the month 01 – 12.

B-7. COMBINED V8/GPM V05 COMBINED PRODUCT NAMING

The Combined product uses data from both the TRMM PR and TMI sensors to retrieve precipitation. For Level 3 products, gridding is on a .25 deg x .25 deg spatial grid.

2B.TRMM.PRTMI.CORRA2107.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5
3A-DAY.TRMM.PRTMI.GRIDCORRA.YYYYMMDD-SHHMMSS-EHHMMSS.DDD.V05A.HDF5
3B-MO.TRMM.PRTMI.GRIDCORRA.YYYYMMDD-SHHMMSS-EHHMMSS.MM.V05A.HDF5

Algorithm ID/versions are only examples; actual ones will be assigned during reprocessing. The daily Level 3 products have “DDD” in the sequence/orbit field to represent the day of year 001 – 366. The monthly Level 3 products have “MM” in the sequence/orbit field to represent the month 01 – 12.

B-8. TRMM V8/GPM V05 LATENT HEATING NAMES

Latent heating retrievals from the TRMM Ku instrument:

2A.TRMM.KU.SLH2H25.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5
3A-ORBIT.TRMM.KU.SLH3G35.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5
3A-DAY.TRMM.KU.SLH3H25.YYYYMMDD-SHHMMSS-EHHMMSS.DDD.V05A.HDF5
3A-MO.TRMM.KU.SLH3H25.YYYYMMDD-SHHMMSS-EHHMMSS.MM.V05A.HDF5

Latent heating retrievals from the Combined Ku and TMI retrievals:

2B.TRMM.PRTMI.CSH2H31.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5
3B-ORBIT.TRMM.PRTMI.CSH3G31.YYYYMMDD-SHHMMSS-EHHMMSS.999999.V05A.HDF5
3B-DAY.TRMM.PRTMI.CSH3H31.YYYYMMDD-SHHMMSS-EHHMMSS.DDD.V05A.HDF5
3B-MO.TRMM.PRTMI.CSH3H31.YYYYMMDD-SHHMMSS-EHHMMSS.MM.V05A.HDF5

Algorithm ID/versions are only examples; actual ones will be assigned during reprocessing. The daily Level 3 products have “DDD” in the sequence/orbit field to represent the day of year 001 – 366. The monthly Level 3 products have “MM” in the sequence/orbit field to represent the month 01 – 12.

B-9. TRMM V8 IMERG FILE NAMES

In TRMM, the merged radiometer data product was known as TRMM Multi-satellite Precipitation Analysis (TMPA, 3B42/43). This product will not be reprocessed. Instead, the merged radiometer/IR product will be the Integrated Multi-Satellite Retrievals for GPM (IMERG). This reprocessing using a version of the GPM IMERG V05 algorithm will be reprocessed back as far as the appropriate IR data exist; currently, this is 2000.

The names will be the same as for GPM and the version will be the GPM version. This means that there will be a consistent IMERG retrieval from the earliest possible year of the TRMM mission through the current GPM-based IMERG. The gridding will be a .1 deg x .1 deg half-hourly global grid.

3B-HHR.MS.MRG.3IMERG.20150101-S000000-E002959.0000.V05A.HDF5
3B-MO.MS.MRG.3IMERG.20150101-S000000-E235959.01.V03D.HDF5

Precipitation Processing System (PPS)



Primer for Tropical Rainfall Measuring Mission (TRMM) Satellite Products in the Global Precipitation Measurement (GPM) Era

Moving from HDF4 to HDF5 Level 2 and Level 3 Products

Version 1.0

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TABLE OF CONTENTS

1.0 OVERVIEW	1
2.0 TMI L2 GPROF	2
3.0 TMI L3.....	3
4.0 PR L2 PRECIPITATION RETRIEVAL	3
5.0 PR L3.....	4
6.0 COMBINED L2	5
7.0 COMBINED L3	5
8.0 L3 TMPA/IMERG	6
9.0 L2 CSH/CSSH	6
10.0 L3 CSH/CSSH	7
11.0 L2 SLH.....	7
12.0 L3 SLH.....	7
ACRONYMS	9

1.0 OVERVIEW

Tropical Rainfall Measuring Mission (TRMM) post-Version 7 products fully incorporate TRMM data into the Global Precipitation Measurement (GPM) mission data processing. TRMM Level 2 (L2) and Level 3 (L3) products have now become part of the GPM data suite. TRMM products are now in GPM HDF5 format and are labeled with product version V05A/V06A. For details on the algorithm caveats and product formats, please see Algorithm Release Notes and the full GPM Product File Specifications (<http://pps.gsfc.nasa.gov>). This is a short introduction to some of the changes for those familiar with TRMM Version 7 products in HDF4 that may now need to read the data in the new HDF5 format.

Reprocessed TRMM products will now be made available in formats similar to those used by GPM products and will use HDF5 (<https://www.hdfgroup.org/>). This is not simply a format change; new GPM-like retrieval algorithms are now used to process TRMM satellite instrument data.

Third-party tools such as IDL and MATLAB can read HDF5 files natively along with the PPS Tool for High-Resolution Observation Review (THOR) data viewer (<https://pps.gsfc.nasa.gov/thorrelease.html>). The PPS Science Algorithm Input/Output Toolkit (TKIO) (<https://pps.gsfc.nasa.gov/gpmtoolkit.html>) can also be used to read the product data for both HDF4 and HDF5 products. TRMM Version 7 products had a limitation in that field names needed to be unique within the product; with HDF5, that limitation has been lifted. The HDF5 files are generally structured into groups that are similar to file directories that can contain other groups or data arrays. For example, to access the data by field name, one can specify the full ‘path’ to a data array, example: ‘/NS/SLV/precipRate’.

Filename conventions for TRMM products in HDF5 follow those of GPM and can be found here (<https://pps.gsfc.nasa.gov/Documents/FileNamingConventionForPrecipitationProductsForGPMMission.pdf>). The following table shows the mapping between TRMM Version 7 and the new HDF5 TRMM product designations.

TRMM Version 7 Designation	New TKIO ID	New Filename Prefix
2A21/2A23/2A25 (PR)	2APR	2A.TRMM.PR.
2A12 (TMI GPROF)	2ATMI	2A.TRMM.TMI.
2B31 (TRMM Combined)	2BCMBT	2B.TRMM.PRTMI.
3A25	3PR	3A-MO.TRMM.PR
3B31	3CMBT	3B-MO.TRMM.PRTMI
2H25	2HSLHT	2A.TRMM.PR.TRMM-SLH
3G25	3GSLHT	3A-ORBIT.TRMM.PR.TRMM-SLH
3H25	3HSLHT	3A-MO.TRMM.PR.TRMM-SLH
2H31	2HCSHT	2B.TRMM.PRTMI.2HCSHT
3G31	3GCSHT	3B-ORBIT.TRMM.PRTMI.3GCSHT
3H31	3HCSHT	3B-MO.TRMM.PRTMI.3GCSHT
3B42	3IMERGHH	3B-HHR.MS.MRG.3IMERG
3B43	3IMERGM	3B-MO.MS.MRG.3IMERG

The following sections give some details on major changes and a mapping for some commonly used fields in TRMM V7 products and the corresponding fields in the HDF5 products. Data can be downloaded from the NASA Precipitation Processing System (PPS) Web portal STORM (<https://storm.pps.eosdis.nasa.gov/storm/>) or directly by FTP (<ftp://pps.gsfc.nasa.gov/>). The FTP area will hold the old Version 7 TRMM data under /trmmdata while the new HDF5 TRMM products will appear under the /gpmdata directory.

2.0 TMI L2 GPROF

For TRMM Microwave Imager (TMI) L2 Goddard Profiling Algorithm (GPROF), file specification documents have to be read to understand the differences of fields between the two versions, even for fields that share the same name in the two versions.

TRMM Version 7 Field in HDF4	TRMM in GPM HDF5
Swath Fields	S1 Fields
	CAPE
qualityFlag	qualityFlag
	L1CqualityFlag
pixelStatus	pixelStatus
surfaceType	surfaceTypeIndex
	Temp2mIndex
landAmbiguousFlag	
landScreenFlag	
oceanExtendedDbase	
oceanSearchRadius	
chiSquared	
probabilityOfPrecip	probabilityOfPrecip
	mostLikelyPrecipitation
	precip1stTertial
	precip2ndTertial
sunGlntAngle	sunGlntAngle
freezingHeight	
surfacePrecipitation	surfacePrecipitation
	frozenPrecipitation
convectPrecipitation	convectPrecipitation
surfaceRain	
cloudWaterPath	cloudWaterPath
rainWaterPath	rainWaterPath
iceWaterPath	iceWaterPath
seaSurfaceTemperature	
totalPrecipitableWater	totalColumnWaterVaporIndex
	spare2
windSpeed	
freezingHeightIndex	
clusterNumber	profileNumber

TRMM Version 7 Field in HDF4	TRMM in GPM HDF5
	profileTemp2mIndex
clusterScale	profileScale
DataHeader Fields	GprofHeader Fields
cluster	clusterProfiles
heightLayerTop	hgtTopLayer
	speciesDescription
	temperatureDescriptions

3.0 TMI L3

The GPM Version 5 L3 TMI product is in the same format as the Version 5 L3 GPM Microwave Imager (GMI) and constellation products. The grid size is 0.25 degree and the coverage extends from 90°S to 90°N, while TRMM Version 7 (3A12) had grid size of 0.5 degree and 40°S to 40°N coverage. Variable changes from TRMM V7 to GPM V5 are listed below.

TRMM Version 7 Field in HDF4	TRMM in GPM HDF5
convectPrecipitation	/Grid/convectivePrecipitation
surfaceRain	
cldWater	/Grid/cloudWater
cldIce	/Grid/cloudIce
graupel	
latentHeat	
	/Grid/frozenPrecipitation
	/Grid/fractionQuality3
	/Grid/surfaceTypeIndex
	/Grid/cloudWaterPath
	/Grid/rainWaterPath
	/Grid/iceWaterPath

4.0 PR L2 PRECIPITATION RETRIEVAL

The Precipitation Radar (PR) L2 Precipitation Retrieval algorithm is very similar to that used in GPM for the Ku-band (Ku) radar with a similar output format. The measured reflectivity (Zm) is now in the L2 product; there is no longer a 1C product.

The vertical binning has changed. The L2 product has 125m slant range bins with bin 176 (1-based) containing the Earth Ellipsoid.

TRMM Version 7 Field in HDF4	TRMM in GPM HDF5
e_surfRain	/NS/SLV/precipRateEstimatedSurface
nearSurfRain	/NS/SLV/precipRateNearSurface
rain	/NS/SLV/precipRate
rainType	/NS/CSF/precipType
correctZFactor	/NS/SLV/zFactorCorrected
1C: normalSample (containing Zm)	/NS/PRE/zFactorMeasured
1C: minechoFlag	/NS/PRE/precipFlag

5.0 PR L3

The L3 product is in the same format as the L3 Dual-Frequency Precipitation Radar (DPR), which contains multiple indices for the Ku, Ka-band (Ka), and DPR retrievals. Since PR is a single-frequency radar, the arrays corresponding to non-Ku frequency data are set to Missing Values. In addition, gridded products are now produced daily for Ascending and Descending parts of the orbit. These daily products are used as input to the monthly gridded L3. The new HDF5 products have two grid sizes: 0.5 deg. and 5.0 deg. Both of these grids are contained in the HDF5 product under /Grids/G1 and /Grids/G2, respectively.

The format of the HDF5 statistics generally follows a grouping consisting of the mean, count, standard deviation, and a histogram.

The TRMM Version 7 product had named fields for separate Convective and Stratiform statistics. The HDF5 product now has these included as indices in the multi-dimensional arrays. Typically, they are separated as Stratiform, Convective, and All. In addition, the HDF5 has statistics for surface types separated within indices as Land, Ocean, and All.

TRMM Version 7 Field in HDF4	TRMM in GPM HDF5
ttlPix1	/Grids/G1/observationCounts
e_surfRainMean1	/Grids/G1/precipRateESurface/mean
E_surfRainPix1	/Grids/G1/precipRateESurface/counts
rainMean1	/Grids/G1/precipRate/mean

6.0 COMBINED L2

2B31 -> 2BCMBT

TRMM Version 7 Field in HDF4	TRMM in GPM HDF5
dHat - Mean drop diameter (mm) x 100	/NS/precipTotPSDparamLow, /NS/precipTotPSDparamHigh - Particle size distribution, parameters Nw and Dm, see 2BCMB Algorithm Theoretical Basis Document (ATBD)
rHat - Instantaneous rain rate (liquid only) at the radar range gates (mm/hour) x 10	/NS/precipTotRate (mm/hour) * /NS/liqRateFracTrans
graupel - Graupel content estimated at the radar range gates (g/m ³) x 1000 plus snow - Snow content estimated at the radar range gates (g/m ³) x 1000	/NS/precipTotWaterCont * (1 - /NS/liqMassFracTrans) (g/m ³) (total precipitating ice)
rrSurf - Surface rainfall rate (liquid only) (mm/hour)	/NS/SurfPrecipTotRate (mm/hour) * /NS/surfLiqRateFrac
prSurf - Surface precipitation rate (liquid plus solid) (mm/hour)	/NS/SurfPrecipTotRate (mm/hour)

7.0 COMBINED L3

3B31 -> 3CMBT

For all TMI, see Level 3 TRMM TMI in GPM V05.

TRMM Version 7 Field in HDF4	TRMM in GPM HDF5
surfacePrecipCOMB - Surface precipitation from the narrow swath of 2B31 (mm)	/G1/surfPrecipTotRateUn, /G2/surfPrecipTotRateUn (mm/hour)
rainWaterCOMB - Monthly mean rain water content from the narrow swath of 2B31 at each vertical layer (g/m ³)	/G1/precipLiqWaterContent.mean * /G1/precipLiqWaterContent.count / /G1/precipAllObs, /G2/precipLiqWaterContent.mean * /G2/precipLiqWaterContent.count / /G2/precipAllObs (g/m ³) (unconditional mean liquid rain water content)
snowCOMB - Monthly mean snow liquid water content from the narrow swath of 2B31 at each vertical layer (g/m ³) plus graupelCOMB - Monthly mean graupel liquid water content from the narrow swath of 2B31 at each vertical layer (g/m ³)	{/G1/precipTotWaterContent.mean * /G1/precipTotWaterContent.count / /G1/precipAllObs} - {/G1/precipLiqWaterContent.mean * /G1/precipLiqWaterContent.count / /G1/precipAllObs}, {/G2/precipTotWaterContent.mean * /G2/precipTotWaterContent.count / /G2/precipAllObs} -

TRMM Version 7 Field in HDF4	TRMM in GPM HDF5
	{/G2/precipLiqWaterContent.mean * /G2/precipLiqWaterContent.count / /G2/precipAllObs} (g/m ³) (unconditional mean total ice-phase precipitation)
npixTotalCOMB - The monthly number of pixels per grid box	/G1/precipAllObs, /G2/precipAllObs
surfAdjRatio	Not calculated
surfAdjRatioOverlap	Not calculated

8.0 L3 TMPA/IMERG

The TRMM Multisatellite Precipitation Analysis (TMPA) grid of 50°S-50°N at 0.25° latitude and longitude is replaced by the Integrated Multisatellite Retrievals for GPM (IMERG) grid of 90°S-90°N at 0.10°. The 3B42 3-hour product is replaced by the IMERG half-hour product.

If not listed below, variables have the same name but are preceded by the path "/Grid/". For example, "gaugeRelativeWeighting" in TRMM 3B43 becomes "/Grid/gaugeRelativeWeighting" in the GPM monthly IMERG.

TRMM V7	TRMM in GPM HDF5
precipitation (in 3B42)	/Grid/precipitationCal
relativeError	/Grid/randomError
satPrecipitationSource	/Grid/HQprecipSource
satObservationTime	/Grid/HQobservationTime

9.0 L2 CSH/CSSH

For L2 Convective Stratiform Heating (CSH) and Convective Stratiform Synoptic Heating (CSSH), the TRMM 19 layers are replaced by the GPM 80 layers.

If not listed below, variables in TRMM 2H31 have the same name but are preceded by the path "/Swath/" in the GPM 2H products. Thus "latentHeating" in TRMM 2H31 becomes "/Swath/latentHeating" in GPM 2H CSSH.

TRMM V7	TRMM in GPM HDF5
scanTime_sec	/Swath/ScanTime/SecondOfDay

10.0 L3 CSH/CSSH

For L3 CSH/CSSH, the TRMM 19 layers are replaced by the GPM 80 layers. The horizontal grids are unchanged.

All variables in TRMM 3G31 and 3H31 have the same name but are preceded by the path "/Grid/" in the GPM 3G and 3H products. Thus "latentHeating" in 3H31 becomes "/Grid/latentHeating" in the GPM 3H CSSH.

11.0 L2 SLH

For L2 Spectral Latent Heating (SLH), the TRMM 19 layers are replaced by the GPM 80 layers.

If not listed below, variables in TRMM 2H25 have the same name but are preceded by the path "/Swath/" in GPM 2H SLH. Thus "latentHeating" in TRMM 2H25 becomes "/Swath/latentHeating" in GPM 2H SLH.

TRMM V7	TRMM in GPM HDF5
scanTime_sec	/Swath/ScanTime/SecondOfDay
rainType2A25	/Swath/rainType2APR

12.0 L3 SLH

For L3 SLH, the TRMM 19 layers are replaced by the GPM 80 layers. The TRMM grid of 37°S-37°N is replaced by the GPM grid of 67°S-67°N.

If not listed below, variables in TRMM 3G25 and 3H25 have the same name but are preceded by the path "/Grid/" in the GPM 3G and 3H products. Thus "allPix" in TRMM 3H25 becomes "/Swath/allPix" in GPM 3H SLH.

Parts of most variable names have changed:

"shallow" becomes "shstr",
"strat" becomes "dpstr",
"Dev" becomes "Stdv",
add "Cnd" before "Mean" or "StDv".

TRMM V7	TRMM in GPM HDF5
allLHMean	/Grid/allLHCndMean
allQ1RMean	/Grid/allQ1RCndMean
allQ2Mean	/Grid/allQ2CndMean
LHMean	/Grid/LHCndMean
LHDev	/Grid/LHCndStdv
convLHMean	/Grid/convLHCndMean
convLHDev	/Grid/convLHCndStdv

TRMM V7	TRMM in GPM HDF5
stratLHMean	/Grid/dpstrLHCndMean
stratLHDev	/Grid/dpstrLHCndStdv
shallowLHMean	/Grid/shstrLHCndMean
shallowLHDev	/Grid/shstrLHCndStdv
LHMean	/Grid/Q1RCndMean
LHDev	/Grid/Q1RCndStdv
convLHMean	/Grid/convQ1RCndMean
convLHDev	/Grid/convQ1RCndStdv
stratLHMean	/Grid/dpstrQ1RCndMean
stratLHDev	/Grid/dpstrQ1RCndStdv
shallowLHMean	/Grid/shstrQ1RCndMean
shallowLHDev	/Grid/shstrQ1RCndStdv
LHMean	/Grid/Q2CndMean
LHDev	/Grid/Q2CndStdv
convLHMean	/Grid/convQ2CndMean
convLHDev	/Grid/convQ2CndStdv
stratLHMean	/Grid/dpstrQ2CndMean
stratLHDev	/Grid/dpstrQ2CndStdv
shallowLHMean	/Grid/shstrQ2CndMean
shallowLHDev	/Grid/shstrQ2CndStdv

ACRONYMS

ATBD	Algorithm Theoretical Basis Document
CMB	Combined
CSH	Convective Stratiform Heating
CSSH	Convective Stratiform Synoptic Heating
DPR	Dual-Frequency Precipitation Radar
GMI	GPM Microwave Imager
GPM	Global Precipitation Measurement (Mission)
GPROF	Goddard Profiling Algorithm
HDF	Hierarchical Data Format
IDL	Interactive Data Language
IMERG	Integrated Multisatellite Retrievals for GPM
Ku/Ka	Ku-band/Ka-band
L2/L3	Level 2/Level 3
PPS	Precipitation Processing System
PR	Precipitation Radar
SLH	Spectral Latent Heating
THOR	Tool for High-Resolution Observation Review
TKIO	PPS Science Algorithm Input/Output Toolkit
TMI	TRMM Microwave Imager
TMPA	TRMM Multisatellite Precipitation Analysis
TRMM	Tropical Rainfall Measuring Mission
Zm	Measured Reflectivity

GES DISC TRMM DATA HOLDINGS RESULTING FROM TRMM V8 REPROCESSING, July 2018

Dataset Title	New Dataset Name	Old Dataset Mapping
GPM VIRS on TRMM unpacked data L1A 1.5 hours 2 km V05	GPM_1AVIRS_05	TRMM_1A01
GPM TMI on TRMM unpacked data L1A 1.5 hours 13 km V05	GPM_1ATMI_05	TRMM_1A11
GPM VIRS on TRMM Radiance L1B 1.5 hours 2 km V05	GPM_1BVIRS_05	TRMM_1B01
GPM TMI on TRMM Antenna Temperatures L1BASE 1.5 hours 13 km V05	GPM_BASETRMMTMI_05	
GPM TMI on TRMM Brightness Temperatures L1B 1.5 hours 13 km V05	GPM_1BTMI_05	TRMM_1B11
GPM PR on TRMM Echo Power L1B 1.5 hours 5 km V05	GPM_1BPR_05	TRMM_1B21
GPM TMI on TRMM Common Calibrated Brightness Temperatures L1C 1.5 hours 13 km V05	GPM_1CTRMMTMI_05	
GPM TMI on TRMM (GPROF) Climate-based Radiometer Precipitation Profiling L2A 1.5 hours 13 km V05	GPM_2AGPROFTRMMTMI_CLIM_05	
GPM TMI on TRMM (GPROF) Climate-based Radiometer Precipitation Profiling L3 1 month 0.25 degree x 0.25 degree V05	GPM_3GPROFTRMMTMI_CLIM_05	
GPM TMI on TRMM (GPROF) Climate-based Radiometer Precipitation Profiling L3 1 day 0.25 degree x 0.25 degree V05	GPM_3GPROFTRMMTMI_DAY_CLIM_05	
GPM PR on TRMM Reflectivity, Precipitation Characteristics and Rate, at Surface and Profile L2 1.5 hours V06	GPM_2APR_06	TRMM_2A11,2A23, 2A25
GPM PR on TRMM Precipitation Statistics, at Surface and Fixed Heights 1 day 0.25x0.25 degree V06	GPM_3PRD_06	

Dataset Title	New Dataset Name	Old Dataset Mapping
GPM PR on TRMM Reflectivity, Precipitation Statistics, Histograms, at Surface and Fixed Heights, 1 month 5x5 and 0.25x0.25 degree V06	GPM_3PR_06	TRMM_3A25,3A26
GPM PR on TRMM Reflectivity, Precipitation Statistics, Histograms, at Surface and Fixed Heights, Ascending, 1 day 5x5 and 0.25x0.25 degree V06	GPM_3PR_ASC_06	
GPM PR on TRMM Reflectivity, Precipitation Statistics, Histograms, at Surface and Fixed Heights, Descending, 1 day 5x5 and 0.25x0.25 degree V06	GPM_3PR_DES_06	
GPM PR on TRMM Spectral Latent Heating Profiles L2 1.5 hours 5 km V06	GPM_2HSLH_TRMM_06	
GPM PR on TRMM Spectral Latent Heating L3 1 month 0.5 degree x 0.5 degree V06	GPM_3HSLH_TRMM_06	TRMM_3H25
GPM PR on TRMM Spectral Latent Heating Profiles L3 1 Day 0.5x0.5 degree V06	GPM_3HSLH_TRMM_DAY_06	
GPM PR on TRMM Gridded Orbital Spectral Latent Heating Profiles L3 1.5 hours 0.5x0.5 degree V06	GPM_3GSLH_TRMM_06	TRMM_3G25